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MEMOIRS OF THE GEOLOGICAL SURVEY.

ENGLAND AND WALES.

THE

GEOLOGY OF THE NEIGHBOURHOOD OF STOWMARKET.

(EXPLANATION OF QUARTER-SHEET 50 S.W.)

BY

W. WHITAKER, B.A., F.G.S.,

F. J. BENNETT, F.G.S.,

AND

J. H. BLAKE, F.G.S., Assoc.M.Inst.C.E.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
AND SOLD BY
Longmans & Co., Paternoster Row; Trübner & Co., Ludgate Hill;
Letts, Son, and Co., Limited, 33, King William Street;
Stanford, Charing Cross; and Wyld, 12, Charing Cross;
Also by T. J. Day, 53, Market Street, Manchester;
W. & A. K. Johnston, 4, St. Andrew Square, Edinburgh;
Hodges, Figgis, & Co., Grafton Street, Dublin; and
A. Thom & Co., Abbey Street, Dublin.
1881.

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NOTICE.

Quarter-sheet 50 S.W., of which this memoir is an explanation, was surveyed geologically by Messrs. F. J. Bennett and J. H. Blake, under the superintendence of Mr. W. Whitaker.

Mr. Blake, whose share is by far the largest, mapped the northern and central areas, Mr. Bennett the south-western and most of the southern parts, and Mr. Whitaker the south-eastern corner of the map.

This explanation has been prepared by the above officers from notes taken in the field, and supplemented by some published information, which is almost wholly derived from two sources—a number of well sections (some unfortunately of doubtful value), from a paper by the late Rev. W. B. Clarke, and notes of pits from a paper by Mr. J. B. Phear (now Sir J. B. Phear).

Mr. Whitaker has arranged and edited the whole.

H. W. BRISTOW,
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CONTENTS.

	Page
NOTICE by the Director - - - - - - - - -	iii
INTRODUCTION.—Area, Rivers, &c. (1. Streams flowing southward. 2. Streams flowing northward). Formations. (By W. W.) - - -	1
CRETACEOUS and TERTIARY BEDS.—Chalk (1. Valley of the Lark. 2. Stream through Thurston. 3. Valley of the Gipping. 4. List of Fossils). Lower Eocene Beds. Crag. (By W. W., F. J. B. & J. H. B.) - -	2
GLACIAL DRIFT.—Gravel and Sand. (1. Valley of the Brett. 2. Valley of the Gipping. 3. Valley of the Lark. 4. Valleys tributary to the Little Ouse.) Brickearth. Boulder Clay. (By W. W., F. J. B. & J. H. B.) - -	5
POST GLACIAL BEDS.—High Level Brickearth and Gravel. River Gravel and Brickearth. (1. Lavenham Valley. 2. Valley of the Gipping.) Alluvium. (By W. W. & F. J. B.) - - - - - - -	15
Appendix 1.—Coddenham Brook. (By W. W.) - - - -	18
Appendix 2.—Well-sections. (By W. W., F. J. B. & J. H. B.) - -	18
Index of Persons and Places. (By W. W.) - - - - -	26

WOODCUT.—Section of Part of the Claydon Chalk Pit - - - 10

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INTRODUCTION.

Area, Rivers, &c.

The tract to be described, 205 square miles, or more, in extent, is in the central part of Suffolk, includes the towns of Bildeston, Lavenham, Mendlesham, Needham Market, and Stowmarket, and is crossed by the following rivers or streams.

1. *Streams flowing Southward.*

The stream (an arm of the Brett) starting from the drainage of the Boulder Clay round Cockfield, flowing south by Lavenham, then more eastward, and joining the other arm of the Brett above Monks' Eleigh (48, N.W.).

The *Brett*, starting from the Boulder Clay tract round Thorpe Morieux, with a tributary from N. of Bildeston. This river flows southward into the Stour.

The *Gipping*, which rises near Wetherden, and has a longer tributary from the Boulder Clay country round Gedding, &c., with several feeders. The two streams meet below Stowmarket, and the combined stream flows south-eastward. There are other tributaries: on the right from Barking (2) and Great Bricett; and on the left from near Gipping, the Stonhams, and Coddenham (N. & E. of the village). It is worthy of remark, that the valley from the Stonhams is at right angles to the main valley, as also is that of the tributary immediately opposite, on the right; whilst the Coddenham valley runs at a very obtuse angle to the main one, an exceptional thing, as tributaries generally run at an acute angle to the main stream. The Gipping (or Orwell, as it is called below Ipswich) is 35 miles long, and its drainage-area is 257 square miles.

Near Mickfield, at the eastern edge of the map, the head of the *Deben*.

2. *Streams flowing Northward.*

Near the Bradfields the head waters of the *Lark*.

Between Bradfield St. Clare and Bradfield St. George, (with a tributary from Woolpit,) the head waters of the stream that joins the Little Ouse below Euston (50, N.W.), and which is itself joined near Ixworth (50, N.W.) by the stream rising near Beighton and Rougham.

At Mendlesham the head of the stream that flows into the Waveney at Thorndon (50, N.W.)

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Formations.

The various beds shown by colour on the map may be seen from the right-hand column of the following list.

Whilst on an ordinary geological map, in which the Drift is ignored, the whole area would be coloured as Chalk, with the exception of the thin strips of alluvium and two mere spots of Reading Beds in the S.E. corner, as a matter of fact the Boulder Clay occurs over nearly the whole district, the once continuous sheet of this clay having been cut through by denudation along the valleys, and in a few spots on higher ground, and it is in these parts only, therefore, that the beds below are exposed.

It follows from this that the geology of the district is practically confined to the valleys, and chiefly indeed to that of the Gipping.

Pleistocene.	Recent.	Alluvium.
	Post Glacial Drift.	Brickearth.
		Gravel and Sand.
	Glacial Drift.	Boulder Clay.
		Brickearth.
		Gravel and Sand, with occasional Boulder Clay.
Pliocene - - - -		Red Crag.
Eocene - - - -		Reading Beds, with trace of Thanet Beds.
Cretaceous - - -		Chalk.

Besides these, in a well at Combs (*see* p. 19), the Chalk has been pierced, and found to be underlain by Upper Greensand, 10 feet thick, with Gault beneath.

CRETACEOUS AND TERTIARY BEDS.

Chalk.

Although the Chalk is the basement-rock of the district, yet it comes to the surface over very small areas only, owing to the thick mantle of Drift being so rarely cut through by denudation. These small areas may be grouped according to the valleys in which they occur.

1. *Valley of the Lark.*

A small strip has been mapped along the stream below Little Welnetham, at the western edge of the map. W. W.

In the larger outcrop along the other branch of the Lark, N.E. of Rushbrooke, there is a pit on the hill-slope W. of Malting-house Farm, showing about 15 feet of marly chalk, much broken up, with rust-coloured stains in many places, and with many irregular-shaped flints, both scattered and in irregular bands. There is another pit N. of North-hill Cover.

2. *Stream through Thurston.*

A chalk-pit in the low ground E. of Rougham Hall was much grown over at the time the survey was made. There is another pit W. of the road, about 10 chains N. of Thurston Railway Station.

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There are also pits about half a mile N.E. of the Thurston Station, and about a quarter of a mile S. of the church.

In the railway-cutting north of Rougham Heath, part of the ballast of the permanent way rests on chalk.

In a pit at Swinbam Cottages, N.E. of Great Barton, there is a patch of sand and gravel on the chalk. The patch of the last coloured here is an artificial exposure. J. H .B.

3. *Valley of the Gipping.*

Right Bank.

Chalk comes to the surface up the side-valley towards Barking, along the main valley from Gallows Hill southward, with a narrow outcrop until below Great Blakenham, when the outcrop broadens, and in places up the side valley to Offton. W. W.

Chalk has been worked about half a mile E. of Barking Church, in Chalk-pit Cover, where there is a little gravel at the top of the pit, in a hollow in the Chalk.

Barking Chalk-pit, S. of Needham Market, is a large quarry. There are hardly any flints to be seen in the Chalk here. I collected the few species of fossils named in the list on p. 4. J. H. B.

The large chalk-pit, which, as well as the three next to be noted, is marked on the Ordnance Map, about half a mile S.E. of Offton Church, shows about 50 feet of marly blocky chalk, rather soft, with few flints, and dipping slightly north-eastward, covered by about 15 feet of sand (Glacial Drift).

Another pit occurs N.W. of Little Blakenham Church, and N.E. of that church is a very large pit, about 50 feet deep, in soft marly and rubbly chalk, with a few flints. F. J. B.

The pit half a mile E.S.E. of the church shows some 20 feet of chalk, with few flints, but with much yellow-staining. The lines of bedding and of jointing are very generally open, for short spaces, to a depth of an inch or more. At the eastern end there are two very small inaccessible hollows in the top of the Chalk, filled either with a trace of the grey base-bed of the Thanet Sand, or with Drift loam, or with both. By the road there is some very pale greenish-grey chalky earth, with a little sand, and with small chalk-pebbles (? a sort of Boulder Clay).

There are other pits in the Chalk, which will be noticed in the description of the beds above (see p. 7).

Left Bank.

There is an outcrop of Chalk up the Coddenham Valley to above Choppings Hill Farm and to Hemingston, continuous, except near the vicarage, along the right (northern) side, but more irregular on the other side. From this side-valley southwards there is an outcrop along the flank of the main valley, which is continuous except for a patch of Boulder Clay, &c., that sweeps over the Chalk W. of Barham Church (see p. 15), and for a smaller patch of Boulder Clay in a like position at Mockbeggars Hall. There is also an outcrop up the side-valley to Akenham. W. W.

Very marly chalk has been dug in a pit a little N.W. of West Creeting Hall, close to a clay-pit.

About a quarter of a mile N.E. of Needham Market Railway Station, a pit showed chalky Boulder Clay over the Chalk.

There are two pits a little N. of Bosmere Hall, and on the western side of the high road, about half a mile E., is another pit. Chalk has also been got close to the river, a little S.E. of Bosmere Mill, and it may be seen in the road-cutting W. of Beacon Hill. J. H. B.

Coddenham Chalk-pits, a mile N.N.W. of the church, give fine sections, and Mr. BLAKE got a few fossils here; see the list on p. 4.

In Shrublands Park there are old pits along the edge of the sand, which caps the Chalk on the flank of the hill, some of which show the junction of the two (see p. 9).

The pits at the Sorrel Horse and at the southern end of Claydon are also described further on (pp. 9, 10, 15), and there are others that call for no special notice.

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In the old chalk-pit, marked on the Ordnance Map (at its southern edge), about half a mile W.S.W. of Akenham Church, a black smut (irregularly diffused through a thickness of up to 1½ feet of the chalk half-way down the section) was shown along the open (western) side, a length of about 40 yards.

4. *List of Fossils from the Chalk.*

From specimens collected by Mr. J. H. Blake and named by Mr. R. Etheridge.

	Barking Chalk Pit. (Needham Market.)	Coddenham.
Belemnitella quadrata, *Blainv.*	×	...
Avicula	...	×
Inoceraunus mytiloides, *Mant.*	×	...
„ larger species (fragments)	×	...
Ostrea acutirostris, *Nills.*	×	?
„ Normaniana, *D'Orb.*	...	×
„ semiplana, *Mant.*	...	×
Terebratula semiglobosa, *Sby.?*	...	×
Retepora?	×	...

Lower Eocene Beds.

The main mass of the Lower London Tertiaries, the set of beds coming between the London Clay and the Chalk, just runs into our district, at its S.E. corner; but the outcrop is a mere streak, the Drift hiding the older beds, and indeed having almost cut them off.

The greenish-grey clayey sand that next overlies the Chalk, and which is probably the base of the Thanet Sand, may be seen along the edge of the wood west of Mockbeggars Hall, and the boundary-line may be followed round the hill, by that fine old house, to a little east, where the base-bed was again noted.

The boundary then passes into the sheet to the south (48, N.W.), but seems to come on again on the other side of the little valley, though almost wholly hidden by Drift.

In the little wood W.S.W. of Rise Hall, Akenham, I saw, in a small old pit, a litle brown and black clay with sand beneath. These seem to belong to the Reading Beds, and chalk is touched just below in a ditch on the west, with some green-coated flints.

The next sign of the old Tertiary beds is three quarters of a mile off, in the great chalk-pit at Claydon (*see* p. 10). Between these two points their boundary is probably much the same as that of the Glacial Drift, which latter entirely masks them.

At the top of the by-lane just S.W. of Barham Church the grey clay and green sand of the base-bed (of the Thanet Series?) occur, with chalk just below.

The springy and boggy ground in the two hollows (Slade and Hop Yard) S.S.E., is probably caused by the occurrence of this clayey base-bed beneath the sand and gravel of the hill.

"There seems to be a trace of the Thanet Sand at Somersham, due west of the Church and a little off the road leading to it. A little sand with greenish grains was seen in a ditch there."* At the large chalk-pit on the southern side of the road eastward of Little Blakenham, there is a trace of the clayey greensand.

There may, of course, be outlying patches of the Eocene Beds under the thick covering of Glacial Drift, but any such could only be known from well-sections.

* From Mr. Bennett's notes.

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Crag.

No evidence of the occurrence of Crag in our district has yet been found, except the presence of phosphatic nodules in the gravelly bed at the base of the sand that overlies the Chalk in the lower part of the Gipping valley. It is possible, however, that some of this sand may belong to the Crag rather than to the Drift.

Mr. S. V. Wood says, "at Hawks Mill, Needham Market, ... I found a section of highly micaceous laminated clay passing up into micaceous sand,"* which he is inclined to regard as Chillesford Clay. I am in doubt, however, as to this, and think that the clay belongs to the Glacial brick-earth, an opinion in which Mr. Blake agrees.

GLACIAL DRIFT.

Almost the whole surface of our district is formed of Glacial Drift, and of this, moreover, nearly the whole by one division, the Boulder Clay, which occurs as an all but continuous sheet.

Speaking generally, the Glacial Drift may here be divided into two members, the Boulder Clay (the Upper Glacial of Mr. S. V. Wood) and an underlying series (Middle Glacial of Wood), consisting of gravel and sand, sometimes with masses of brickearth at top, and sometimes containing a layer of Boulder Clay.

It will be convenient to describe each division that has been coloured separately on the map.

Gravel and Sand.

This set of beds varies in composition, in some places consisting chiefly of gravel, sometimes coarse, and in others being almost wholly sand. The stones of the gravel are generally of great variety, though chiefly of that very indestructible material flint. There is sometimes a bed of Boulder Clay in this set of deposits.

As these beds crop out chiefly along the bottoms and sides of the valleys, they can best be described under the heading of those valleys.

1. *Valley of the Brett.*

Along the western branch from Cockfield to Brent Eleigh several isolated patches have been mapped by Mr. Bennett, in great part, however, with doubtful boundary-lines.

Along the central branch there is a narrow, but almost continuous, outcrop from Lower Farm, north of Preston, which joins that of the eastern branch along the southern edge of the map.

In that eastern branch the outcrop extends from Hitcham southwards.

W. W.

A pit a quarter of a mile north of Lavenham Railway Station, and west of the road by the windmills, gave the following section :—

Boulder Clay, about 2 feet.
Sandy loam, pinkish at bottom, about 1½ feet.
Rather coarse gravel, about 2½ feet.
Thin layer of rather coarse buff sand, showing small faults.
Very coarse gravel, with large flints, 7 feet.

* *Quart. Journ. Geol. Soc.*, vol. xxxvi., p. 460 (1880).

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A pit by the lane near the stream a little westward of Hatchet Farm showed River Gravel (too small a patch to map, and included therefore with the alluvium) over Boulder Clay, over gravel and sand, to a depth of 2½ feet.

The following section occurred N.W. of Highland Farm, a mile S. of Kettlebarston Church :—

Boulder Clay, thickening towards the valley, with a 3-inch bed of coarse gravel at bottom, cutting across the beds below.
Pebbles (many of quartz) in a sandy matrix, 4 feet.
Fine white sand, bedded with layers of white clay, 5 feet.

In a small grove on the western side of the lane, nearly three quarters of a mile S.W. of Bildeston church there is a deep old pit, now much overgrown, showing Boulder Clay, through which sand, gravel, and Chalk rise in a boss to the surface. The Boulder Clay thickens towards the valley, and at one part rests on the Chalk, from which it is elsewhere divided by sand and gravel. A mass of fine sand, and of pebbles in a sandy matrix, fills a pipe in the Chalk.

A small cutting on the road up the hill, over half a mile southward of Bildeston church, shows two bosses of gravel rising up through the Boulder Clay. F. J. B.

2. *Valley of the Gipping.*

It is along this valley (and its tributary valleys) that the beds below the Boulder Clay are chiefly shown. The gravel and sand outcrop throughout the main valley, generally on both sides, and moreover in some breadth across the watershed, westward of Wetherden, between the Gipping and the stream at Woolpit. A like occurrence may be noted in the watershed between the valley of the Lark, north of Rushbrooke, and the Thurston valley. W. W.

Light-brown sand, 40 feet thick, more or less diagonally bedded at the lower part, is exposed in a pit by the side of the road leading to Tithe Farm, a little N.E. of Stowmarket Railway Station.

Another pit, a little S.E. of the above, showed 7 feet of gravel on 23 feet of loamy sand, which latter is much used for foundry-work. There is no clear line of demarcation between the gravel and sand, but each appears to wedge into the other irregularly.

Good sections of gravel and sand were exposed in the brickyard about a quarter of a mile west of Stowmarket church (*see* p. 13). One section showed 10 feet of gravel with large irregular and lenticular patches of light-brown fine sand.

Another pit, a little south of the brickyard on the slope of the valley, showed 9 feet of gravel resting on loam and sand.

There are also sections in the tributary valley west of Stowmarket, which may now be described.

North of the road, and about half a mile N.E. of Rattlesden, a pit gave the following section :—

Reddish and grey brickearth, more clayey towards the top, with a few angular flints, 4 feet.
Coarse gravel, with many rounded and angular boulders, mostly of flint, but some of sandstone, limestone, &c.; one of sandstone measuring 18×10×5 inches. Rests on an undulating surface of the bed below.
Mottled reddish-brown and white sand.

In a pit about half a mile N.E. of Great Finborough, a depth of 10 feet of fine buff sand is exposed, with lenticular patches and wedge-shaped masses of gravel. The sand shows current bedding, and the gravel mostly consists of flints.

A pit about 20 chains south-east of Onehouse Church, in a field north of the road, showed about 12 feet of gravel. The top 3 feet is very coarse, then

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follows a foot of very fine gravel resting on 3½ feet of very coarse gravel containing many flint boulders, succeeded by 3½ feet of very fine gravel, more or less bedded. On the northern side of the pit 1½ feet of boulder clay is exposed on the top of the gravel, and a wedge-shaped mass, a foot thick, in the middle of the very coarse gravel. Another wedge-shaped mass of very fine pale grey pipe-clay occurred in the fine gravel at the bottom. J. H. B.

Continuing along the right side of the main valley, a pit in a field, above the high road, half a mile S.W. of Bosmere Hall, gave a section of gravel, mostly coarse, the lower part chalky, and at one spot with many broken up Crag shells (1881).

The section of the railway-cutting and ballast-pit at Gallows Hill, about a mile S.E. of Needham Market Station, was thus noted by MR. J. B. PHEAR in the only paper I know of that treats (more than incidentally) of the geology of our district, except for the well-sections in the paper by MR. CLARKE, quoted in the Appendix :—

Dark rough gravel, with loamy clay and sand, like that of the gravel-pit just above.
The layers [of gravel] whiter and distinctly bedded.
Layer of fine whitish loam, with a bed of fine chalky gravel containing *Belemnites*, &c.
White sand.

"The greatest depth exposed is between 60 and 70 feet [this must be over-estimated]. The strata are much bent, and many slips [small faults] can be seen." I found in the overgrown ballast-pit some fragments of Crag shells (1881).

MR. PHEAR has also noted an old chalk-pit at the northern side of the entrance to the short side-valley, nearly a mile southwards, "at the top of which is a mass of large pebbles and sand," whilst just above "is an old marl pit"* (Boulder Clay).

About half a mile N.E. of Baylham Church I saw a section of sand, with some phosphatic nodules (? Crag) at the bottom, over chalk.

A little west of Great Blakenham Church, gravel overlies the Chalk.

In a chalk-pit west of Blue Barn, and about three-quarters of a mile S.S.W. of that church, there is a pipe of sand, with the nodule-bed (Crag ?)

About half a mile N.E. of Somersham Church, a small pit showed Boulder Clay cutting into the sand. W. W.

In the tributary valley of Somersham there is a fair exposure of Glacial sand, between that village and Offton. The sand is fine and light-coloured, contains some black flint-pebbles, and gives rise to a sharply cut slope. It is shown at Offton chalk-pit (*see* p. 3). F. J. B.

My colleague MR. BLAKE has no notes of sections in the tributary valley of Creeting and Stonham, north of Needham, probably from the pits having been disused, but MR. PHEAR has published the following notes.

"On Deerbolt's farm, several pits situated at different levels . . . . . respectively worked for gravel, sand, and brick-earth : the highest exposes alternate layers of fine brick-clay and sand capped by an unstratified mass of earthy rubble; the workmen represent the base of this to be a stiff chalky clay . . . . . ; the lower pits give thin layers of sand and brick-earth upon a floor of angular flints," in which last "a group of bones of some large mammal were lately found." This probably refers to pits in the valley westward of the farm, and to beds which crop out from beneath the Boulder Clay of the hills, though MR. PHEAR took them to overlie the latter. The bed of angular flints, with bones, may, however, be Post Glacial.

"A large sand-pit immediately below Hill-farm . . . . perhaps 20 feet high," showed alternate layers of fine brick-clay and white chalky sand, the latter with broken *Belemnites*, &c., small spots like powdered carbon, and full

* On the Geology of some parts of Suffolk, particularly of the Valley of the Gipping."—*Trans. Cambridge Phil. Soc.*, vol. ix., pt. iv., pp. 436, 437 (1856).

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of fragments of white shells, besides some more perfect specimens of *Murex* [*?Purpura*], and pieces of bivalves coloured like those of the Red Crag. At the base the sand is pure.

"At Woolney Hall . . . . this low gravelly portion [of the valley] contains a mass of soft white brick-clay."

"Immediately under Creeting Chapel [? Creeting St. Mary Church], a sand-pit . . . . when fresh cut exhibited a section of about 20 feet . . . ., showing alternate horizontal strata of sand and fine clay." *

We may now pass to the tributary valley on the left side, east of Needham Market.

In the stream-course nearly two thirds of a mile above Hemingston Hall chalk was seen, overlain by sand.

At Hemingston the sand and gravel rises to the top of the hill, on the northern side of the church, where there is a large old pit in these beds: the section is mostly hidden, but the bottom part shows interbedding with reconstructed chalk. The Boulder Clay is at a much lower level on the west.

Mr. Phear has thus noted a "small section afforded by a pit exactly opposite Hemingston Hall." †

Irregular gravel with pieces of *Gryphæa*, &c.
Irregular layers of sand (full of small pieces of chalk) and small pebbles.
White sand (taking up more than half of the section).

In the northern branch of this valley, Mr. G. Maw made an interesting discovery in these beds, which he has thus chronicled: "I obtained between Coddenham and Crowfield, in Suffolk, a number of fragments of shells from the outcrop of a bed of clean gravel, which at the latter place is *overlain* by 60 feet of Boulder-clay." ‡

In the pit just N.N.E. of Choppings Hill Farm (Coddenham), the upper part of which is somewhat hidden by talus, the following section was noted:—

Boulder Clay, at highest part, a few feet.
Stony bed: sandstone and conglomerate, up to about a foot. Some blocks, by the road, up to 20 inches thick.
Gravelly sand, mostly hidden, ? 15 feet in all. The lower part of the pit shows this sand, sometimes with a gravelly layer at the bottom (containing a few small decomposed phosphatic nodules).
Chalk, about 10 feet.

I saw some small pieces of shell in the talus of sand; so perhaps this may be the spot where Mr. Maw got the shells. As will be seen from the following notes, however, I have a suspicion that some of the shells hereabouts may have been derived from the destruction of Crag.

A small old pit at the lower corner of the eastern end of Needham Plantation, nearly half a mile N.W. of Coddenham church, showed gravelly sand, with a good deal of broken-up shells, looking like re-arranged Crag.

At the back of the cottages on the foot-path between the two Coddenham chalk-pits, about a mile W.N.W. of the church, there has been dug what looks like a mixture of Boulder Clay, gravel, and sand, in which I found some pieces of shells, probably derived from the Crag.

Down the slope of the northern of the two chalk-pits there is brown stony soil and chalk-rubble above the chalk. It is thicker at the lower (western) part, where it seems to include some patches of pale weathered Boulder Clay.

An old pit, on the eastern side of the little valley, about a mile N.W. of Coddenham church, showed the following beds:—

Soil and a little pebbly gravel.
Light-coloured sand, more or less bedded (as far as could be seen), with a nearly vertical thin vein with calcareous matter (? from decomposed

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* *Trans. Cambridge Phil. Soc.*, vol. ix., pt. iv., pp. 437, 438 (1856).
† *Trans. Cambridge Phil. Soc.*, vol. ix., pt. iv., p. 434.
‡ *Geol. Mag.*, vol. i., p. 295 (1864).

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shells. I saw a bit of shell, just at the head of the valley, close by, 12 feet or more.

Chalk (touched at one spot, hidden by wash elsewhere); top foot hard, the upper part very so, and dark in fresh fracture. This hard top contains flints.

A little northward, between the last section and Coddenham Row, an old pit, on the same side of the little valley, shows Boulder Clay underlain by stone, which is the result of the cementation of the sand.

"At Bridge Place....on the left [of the high road] ascending Creeting hill, is a large deep chalk-pit, in the side of which towards the valley is an irregular opening of considerable size, stopped up by a mass of rough pebbly gravel and reddish sand: this opening has all the appearance of being the transverse section of a cavern, and the materials filling it are the same .....as those of the adjoining sand-hills."* Above this chalk-pit I saw a section of gravel over sand.

Returning to the left side of the main valley, at the top of the ridge dividing it from the tributary valley, at Beacon Hill an old pit showed a trace of Boulder Clay, over gravel, over sand. Another old pit on the same hill, three quarters of a mile N.W. of Shrublands Old Hall, also shows Boulder Clay over gravel.

In Shrublands Park a pit about a quarter of a mile N. of the house gave the section below :—

Fine light-coloured sand, mostly whitish, with a few lines of clay, nearly 20 feet.

Layer of flints and pebbles, with a few phosphatic nodules, resting fairly evenly on.

Chalk, with a few flints, about 20 feet.

It is a question whether this sand may not belong to the Chillesford Beds rather than to the Drift; but in the absence of evidence it would be unadvisable to map it as such.

The road along the eastern edge of the park was altered some 30 years ago, in order to enlarge the park. The cutting at its southern end, east of the Hall, is now for the most part overgrown (1875), but shows a little pale sandy Boulder Clay at top; then a mass of brown sand and gravel; and then light-coloured, nearly white, sharp sand. This lowest sand may belong to the Chillesford Beds (or to the Red Crag) instead of to the Drift.

The old road, now in the park, just to the west, has been opened out on either side for sand, close to the top of the hill. On its eastern side there is brown, buff, and whitish sand, with layers of clay, and at the bottom nearly white sand (as before). On the western side the following beds occur :—

Pale Boulder Clay, evenly bedded, as shown by thin brown layers in the bottom part, up to 6 or 7 feet.

At one part about a foot of grey clay (= the brick-clay of the brickyard to the N.E., see p. 14).

At another part some two feet of brown loam and sand.

Whitish sand as before.

A small old pit just westward shows a little Boulder Clay over sand, mostly whitish.

Near the base of the sand about half a mile W. of N. from Barham Church there are signs of a layer of Boulder Clay, which, however, I could only trace for a short distance.

The large chalk-pit on the high road S.W. of Claydon church gives a most remarkable section, showing a mass of Boulder Clay apparently intruded beneath older beds. The top part of the pit was, however, mostly inaccessible, except on the north, where it was much overgrown, the working being on the south at the time of my visit (1875). In the woodcut the part then clear is alone represented, extending to a point about 20 yards from the hedge by the foot-path on the south.

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* J. B. Phear, *Trans. Cambridge Phil. Soc.*, vol. ix., pt. iv., pp. 434, 435 (1856).

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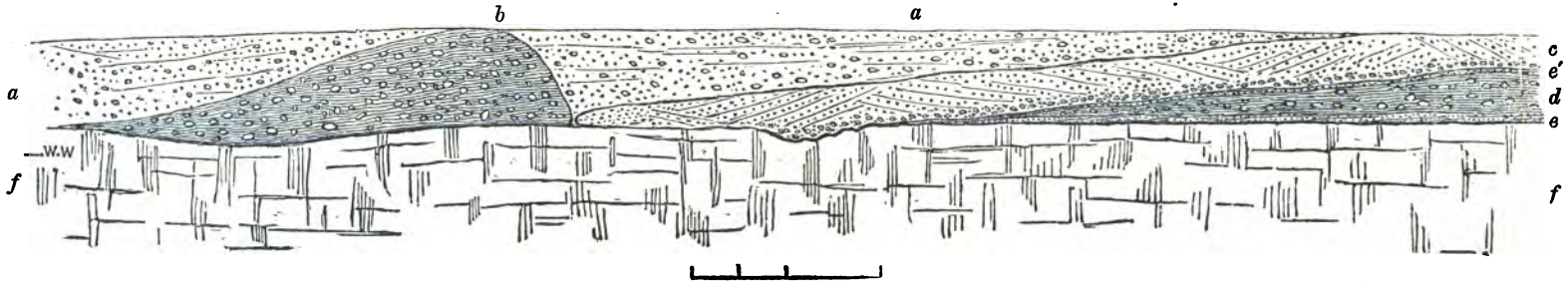
Section of Part of Claydon Chalk Pit, 1875.



Scale, vertical and horizontal. 30 *feet to an inch.*

a. Sand and gravel, somewhat bedded, with a thin layer of grey clay near the top.

b. Pale Boulder Clay (may be the same bed as *d*.).

c. False-bedded coarse ferruginous sand, partly hardened into iron-sand-stone: a gravelly layer at the bottom, from bits of which lying about in the pit I got some phosphatic nodules: a hollow of flints at one spot, over the Chalk. Much like the Crag sand from which the shells have been dissolved out.

d. Grey Boulder Clay; with a layer of the grey clay and a little of the greensand of the "base-bed" (Thanet) *along the top, e'* (*d* may be the same bed as *b*.).

e. Clayey greensand (base-bed of Thanet Beds), with green-coated flints, up to 1½ feet thick.

f. Bedded Chalk, almost flintless, 50 feet or more, and worked 10 feet deeper in another part. Small species of *Ostrea*, as at Needham Market.

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From this pit towards Akenham there are signs of the presence of a layer of Boulder Clay in the sand and gravel, and I differ from Mr. S. V. Wood* in regarding the Boulder Clay of the pit as also being in the sand and gravel, rather than as belonging to the great mass of the Boulder Clay that comes on above.

In a pit by the lane about a quarter of a mile eastward of Akenham Church, in a tributary valley, there was for the most part at the top pale Boulder Clay, resting unevenly on irregular gravel and sand, with nearly white sand below. The gravel runs some way up the lane westward, whilst the Boulder Clay occurs lower down eastward.

The Boulder Clay plateau near Henley is broken through in a few places by the rising up of the gravel and sand from beneath, so that outcrops of these lower beds occur surrounded on all sides by the Boulder Clay. The largest of these is on the west of the high road, from near Barham Green to near Henley Church, and is not far from joining on to two others, on the south and east. At the windmill sand and gravel were shown. A fourth of these inliers occurs nearly a mile S.E. of the church, and has a gravel-pit, whilst the fifth and smallest is at Riggs Hall, on the east.

A pit in the field just S.W. of Riggs Hall gave the following succession :—

Very small patch of Boulder Clay.
Gravel and sand.
Sand, 12 feet thick on the eastern side, where there is nothing else but this bed.

W. W.

3. *Valley of the Lark.*

In a pit on the slope of the valley west of Kiln Grove north of Rushbrooke, the sand is laminated and dips towards the valley; is of a buff colour, also white, yellow, and brownish red, variously intermixed; white sand being exposed at the bottom. A few small pebbles are intercalated in some places, and a 9-inch band of rather plastic grey clay.

4. *Valleys tributary to the Little Ouse.*

There is a large sand-pit near Malting Farm, a quarter of a mile N.E. of Thurston Railway Station.

In a well about ⅛ mile S.E. of Thurston church about 30 feet of sand was dug through, when chalk was reached.

About a quarter of a mile east of Woolpit church a patch of sand occurs 12 feet thick, resting on gravel. The sand contains thin bands of grey plastic clay and thin bands consisting mostly of chalk grains.

In a gravel-pit a quarter of a mile N.W. of Warren Mill, on the slope of the small valley, 12 feet of gravel and sand were exposed.

A large gravel-pit, three eighths of a mile N.W. of Norton church, gave the following section :—

Occasional irregular patches of sandy brickearth.
Chalky Boulder Clay; 5 feet.
Buff gravel; mostly of well rounded flints, averaging from 2 to 4 inches in diameter; 14 feet.
Very light buff sand, little exposed.

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* *Quart. Journ. Geol. Soc.*, vol. xxxvi., pp. 498, 504 (1880).

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About six chains further north another large pit showed the following beds:—

Chalky Boulder Clay (at the side of the pit).
Gravel (like that in the above section), the top part the coarser; 18 feet.
Well-bedded sand and gravel, in thin layers, mostly consisting of small chalk pebbles and chalk grains; 9 feet.

Lenticular layers of light-brown brickearth, from 2 to 9 inches thick, occur in places both in the gravel and in the sand. J. H. B.

Brickearth.

The loam or brickearth that occurs in places in the Glacial Drift is of economic importance, and it is convenient to describe it separately. Though taken after the sand and gravel, this must not be understood as implying that it is of later date; for it will be seen that whilst in some cases brickearth overlies gravel and sand in other cases the reverse holds, and indeed the brickearth seems to be an included mass in the midst of the other beds. Mr. S. V. Wood has concluded that the laminated and more or less contorted brickearth to be seen in many of the sections to be described, really belongs to the "Contorted Drift" of his "Lower Glacial," and that the exposures of it are mere humps, as it were, of a large and more or less continuous mass that underlies the Boulder Clay and the gravels over a large area.* For my own part I am rather inclined to regard the brickearths (of this district at least) as lenticular masses in the gravels and sands ("Middle Glacial" of Mr. Wood). Many sections of like beds in the district to the south-west have been described in one of the *Geological Survey Memoirs*.†

Small deposits of brickearth, at Woolpit and Needham Market, which may be newer than the Boulder Clay, have been included in the following description (pp. 13, 14). These contain carbonaceous matter. W. W.

In the road-cutting S. of Lavenham Hill Farm,‡ and nearly opposite the milestone a mile N. of Lavenham, laminated clay with "race," 7 feet thick, was seen, showing a vertical junction with the Boulder Clay, and probably rising as a boss through the latter; but, being seen nowhere else, it has not been mapped.

A pit, much hidden and grown over, in a field about half a mile N.N.W. of Rushbrooke Church, gave the following section:—

Buff sandy laminated clay, 6 feet.
Grey and white laminated clay with sandy partings, 2½ feet.
White sand touched.

F. J. B.

In the old pit just S.E. of Barton Mere (in 50, N.W.) and E. of the road, about a mile N.N.W. of Thurston Railway Station, the section is much hidden. At the S.E. end there is laminated grey clay, or loam, with sand-partings, lying in a narrow hollow, into which it dips down on either side (and along the course of which the pit has probably been worked), underlain by brown loam, mostly sandy. Close by, north-westward, the brown loam is overlain by Boulder Clay on one side of the pit (S.W.), and underlain by Boulder Clay on

* See *Quart. Journ. Geol. Soc.*, vol. xxxiii., p. 107.

† On Sheet 47. "The Geology of the N.W. Part of Essex and the N.E. Part of Herts. With Parts of Cambridgeshire and Suffolk," pp. 34–58 (1878).

‡ Wrongly named "Lavenham Hall," on the Ordnance Map.

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the other side. Further on Boulder Clay comes on at top, with sandy and gravelly pockets, and it seems to be jammed against the brown loam. At the N.W. end, towards the mere, gravel has been worked. W. W.

It is stated that, from the time of Queen Elizabeth to the present period, Woolpit has been famous for its manufacture of white bricks. Excellent red bricks are also made there. Some fine buff brickearth occurs in the hollow about half a mile N.W. of Woolpit church, but it is not worked.

About half a mile east of the church there is a large brickyard where some of the best brickearth for making white bricks is obtained in the neighbourhood. Boulder Clay is shown above the brickearth in the sections in this and the other brickyards. The greatest thickness of brickearth is about 30 feet, the upper 15 feet consisting of laminated light-brown loam with thin bands of grey clay, and the lower 15 feet or more consisting of a dark bluish-grey plastic clay, from which the best white bricks are made. Occasional thin ferruginous bands, about a sixteenth of an inch thick, occur interbedded with the laminated light-brown loam, pieces of which can easily be detected in every brick that contains them, and which are apt to lower the quality of the bricks by producing unsightly rusty stains down the face of a wall built with them. As a general rule, however, the bricks are excellent, and free from discolouring matter.

About three quarters of a mile east of Woolpit, at Cranmore bridge, there is another large brickyard, where a good section is exposed, showing 5 feet of Boulder Clay of a light marly character, containing many chalk-stones, resting upon 4 feet of dark bluish clay, which latter overlies 10 feet of laminated buff-coloured brickearth. Excellent white and red bricks are made in this brickyard.

In a large pit about two thirds of a mile E.S.E. of Woolpit church, where brown brickearth 16 feet thick was exposed, the greater part is very free from flints; red bricks are mostly made from it.

At Crossways, half a mile N.E. of Woolpit, 12 feet of brown brickearth occurs, resting on 2 feet of black earth consisting of much carbonaceous matter, leaves, pieces of wood, &c., all in a blackened condition, together with some bones, &c., beneath which there was shell-marl. This deposit is probably more recent than the Boulder Clay adjacent, but its relation was not clearly shown.

In the carbonaceous matter, the following bones, &c., were found:— Tooth and fragments of teeth of *Bos*; distal end of right humerus, glenoid cavity of scapula, horn cores and portions of horn of *Cervus*.

In the shell-marl were found fragments of *Planorbis, Limnæa* and *Valvata piscinalis*.

Some good brown loam, suitable for brick-making, occurs underlying the Boulder Clay about half a mile east of Wetherden church, north of the road leading to Haughley. Light-brown sand underlies the loam, and in certain places is more or less mixed with it, thus deteriorating from the quality of the brickearth. Bricks were formerly made here.

Light-brown loam, suitable for brick-making, occurs S.E. of Onehouse, 2 miles west of Stowmarket; but it is not worked, and there is no good exposure.

Good light-brown brickearth, underlying the Boulder Clay, occurs east of the railway at Boards Farm, about a mile north of Stowmarket. The deposit, which has been much excavated, gets attenuated to the south, and apparently thins out in the sand under the Boulder Clay on the slope of the valley.

At the large brickyard about a quarter of a mile west of Stowmarket Church the brickearth is about 35 feet thick, of a buff colour, laminated, and very much contorted, the thin beds overlapping one another considerably.

One of the sections here was as follows:—

Reddish-brown loam, 6 feet,
Boulder Clay, 5 feet.
Sand and gravel, a foot.
Laminated buff evenly bedded brickearth.

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Another section showed the following succession :—

Gravel, 6 feet.
Light-brown fine well-bedded sand, with lenticular patches of gravel, 10 feet.
Brickearth, 7 feet.
Boulder Clay.

The beds are waved, and both gravel and sand had irregular black stains in places, and contained many quartz-pebbles.

There is much gravel in this brick-yard, mostly on the surface, but in places the gravel and boulder clay apparently interlace with the brickearth. A well here gives evidence of the thickness of the Drift (*see* p. 25).

About 15 chains south of the above brickyard, near Abbot's Hall, a pit on the slope of the valley gave the following section :—

Gravel, 9 feet.
Brickearth, with some interbedded sand, and, at the base, a ferruginous sandy laminated bed ; 5 feet.
Brown false-bedded sand, showing an apparent unconformity, but not necessarily an interval of any great length of time ; 15 feet.

The thickness of the brickearth in this pit being only 5 feet, whereas from 200 to 300 yards further north it is 35 feet, tends to show the local and irregular nature of this deposit.

There used to be a brickyard south of Stowmarket, by the side of the road a little north of Combs Ford, but the site is now occupied by houses and gardens.

Brickearth, sand, and gravel are obtained from a pit three eighths of a mile N.W. of Needham Market Church. They are more or less stratified and dip towards the valley, being overlaid with Boulder Clay.

At the brickyard three quarters of a mile S.W. of the church, the loam appears to overlie the Boulder Clay, and has carbonaceous matter at its base in which bones have been found. J. H. B.

It is possibly to the last section but one that Mr. Phear refers as "on the left-hand side of the road from Needham to Stowmarket, just as it leaves the former town," and as showing a "thin layer of chalky gravel," over "white brick-clay, perhaps 20 feet thick." "On the other side of the road adjoining Hawk Mill is another pit of the same kind, in which some depth of sand overlies the brick-earth." *

In the brickyard, marked on the Ordnance Map, in the hollow three quarters of a mile S.W. of Hemingston Church, there is grey bedded clay, apparently cropping out from beneath the Boulder Clay above. I was told that "stony clay" had been found on the brick-clay in places, and that below it there was sometimes a hard black bed (of no use), and sometimes springy coarse sand with stones.

The brickearth seems to have been worked northwards, to the cottage, where a ditch and ponds show that there is Boulder Clay at a higher level, and clean clay at a lower.

Boulder Clay.

This deposit is of the usual character, a bluish-grey clay, with stones of various sorts and sizes, chalk being more common than all others together, and sometimes so plentiful as to give a whitish appearance. These included stones mostly show the common mark of glacial origin, grooved surfaces.

The Boulder Clay forms the surface of by far the greater part of our district, being a continuous sheet, except where cut through by the chief valleys, or, in the much rarer cases, where it is covered by patches of loam or gravel. Its thickness too is considerable, as may be seen from the well-sections (p. 18, &c.), some of which

* *Trans. Cambridge Phil. Soc.*, vol. ix., pt. iv., p. 438 (1866).

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certainly show a thickness of 100 feet, whilst others may perhaps extend this to 150 or more.

Few of the sections have any special interest, or need description, except when the junction with other beds is shown, and these have been already described for the most part. W. W.

In a clay-pit by the side of the hill (on which are two windmills) about midway between Woolpit and Drinkstone, there was a large quartzose sandstone boulder, with numerous ferruginous concretions on it, and much striated, which measured 3×3×2 feet. J. H. B.

The section of the deep railway-cutting S.E. of Stowmarket Station is now much hidden; but it has been described by Mr. Phear as "a good section, 60 or 70 feet high of pure *blue* clay-drift," over sand, of a ferruginous red at top, but white below. "The line of junction of the clay and sand, as far as it can be traced, is very irregular; and at both extremities of the cutting the sand apparently gets confused with a mass of singularly rough gravel full of boulders of all sizes. * The depth is not so great as stated however. W. W.

Patches of sand and brickearth occur in the boulder clay in the road leading south from Creeting Green towards West Creeting Hall, about 6 chains south of a small house to the west of the road, and 10 chains west of Creeting St. Peter Church.

A pit about 20 chains north-west of West Creeting Hall, showed about 12 feet of clay, with many boulders, resting on the Chalk. One Lias limestone boulder, projecting in the clay, measured 2 feet across, and was much scratched; but another, at the bottom of the pit, measured 9×5×1½ to 2 feet. This boulder consisted of two beds of limestone with a little shale between, contained many *Ammonites* and veins of spar in septaria form, and had scratches on its surface. J. H. B.

A pit at the back of the Sorrel Horse, opposite the southern entrance to Shrublands, gave the section below:—

Irregular Boulder Clay, up to 5 feet.
Patches of gravel and sand in places.
Chalk.

An old pit in a field about half a mile E. of the House of Industry (the workhouse), Barham, showed Boulder Clay, with some lenticular patches or layers of gravel, sand, and fine loam, the gravel sometimes almost wholly composed of chalk-pebbles. In the fields near by, there seem to be many such intercalations, but it is impossible to show them on the map, and all have been massed with the Boulder Clay.

It is possible that some of the patches of this clay in the lower parts of the valley of the Gipping hereabouts may not belong to the great mass that caps the hills, but may rather be a lower bed, associated with the gravel and sand (*see* p. 5).

POST GLACIAL BEDS.

To prevent misunderstanding, it may be as well to state that the term Post Glacial is here used in a local sense, to include beds of later date than the Boulder Clay of the district. These take up but a small area, being mostly confined to the valleys, though some patches (older than the gravel of the valleys) occur on the Boulder Clay plateau.

* *Trans. Cambridge Phil. Soc.*, vol. ix., pt. iv., p. 439 (1856).

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The classification of a variety of gravels, etc. under this general heading is a mere matter of convenience, a short memoir like this not being the place for a discussion on the classification of these deposits. W. W.

High Level Brickearth and Gravel.

On the high grounds of Drinkstone, Tostock, Elmswell, Woolpit, and Shelland there is gravel over the Boulder Clay, but which nevertheless may belong to the Glacial Drift, as gravels in a like position in other parts of East Anglia seem to do.

A little west of Drinkstone church, close to the alluvium, 18 feet of gravel is exposed in a pit.

Coarse gravel, of flints, with many quartz and other pebbles, occurs on the top of the hill N.E. of Drinkstone, where two windmills are situated. On the southern side of the hill there are some pits which show the gravel resting on Boulder Clay; but on the northern side, which has a more gradual slope, the gravel continues down to the alluvium.

In the large gravel pit about half a mile S.W. of Tostock church, 18 feet of flint gravel is exposed, which is much used for the metalling of roads.

Gravel and sand, together 9 feet thick, were exposed in a small pit in a field east of Elmswell Church, south of the road, and in a good road-section, close by the church, gravel was seen overlying the Boulder Clay. J. H. B.

Mr. Blake has noted "about 4 feet of brown loam on the top of the Boulder Clay, in the brickyard at Bradfield St. George." It is a question whether this may not be analogous to loam described in another Geological Survey Memoir as overlying the Boulder Clay in the district to the S.W.* W. W.

Distinct from the Glacial Gravel and from the River Gravel there is, in the south-western part of the district, a high level gravel resting to all appearance in the hollows in the Boulder Clay. This gravel makes no feature, and so has only been mapped just round the pits where it is worked, which are not open any length of time, but are soon filled up.

It is very coarse, and contains large flint pebbles; the matrix is clayey.

In the railway-cutting just N. of Cockfield Station, some small pockets of this gravel may be seen resting on the Boulder Clay in which the cutting is made.

Just off the road from Cockfield to Lavenham, on either side, and about a quarter of a mile south of Cross Green, a pit showed the section below:—

Very coarse gravel, large flints in a clayey matrix, 6 feet.
Rather finer angular gravel, 2 feet.
Sand touched at bottom.

A mile S. of Cockfield Church, a little east of the high road, another pit showed 5 to 6 feet of coarse red gravel, Boulder Clay being touched at the bottom at one place.

The town of Lavenham seems to have been built on this gravel, and a pit a quarter of a mile N. of the church, just off a lane, showed 8 feet of rather coarse gravel. In this pit have been found two long tunnel vaults, the arches being turned in tiles, and the age unknown.

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* The Geology of the N.W. Part of Essex, &c., (Explanation of Sheet 47), pp. 62–64 (1878).

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River Gravel and Brickearth.

1. *Lavenham Valley.*

At the brickyard on the right bank of the stream on the eastern side of Lavenham, the section showed 9 feet of brickearth and gravel, dovetailed, and containing bones and flint-flakes, resting on Boulder Clay. Mr. H. Prigg, of Bury St. Edmunds, tells me that he has got from this pit part of a tusk of *Hippopotamus major*, a second molar of *Rhinoceros leptorhinus*, a molar of a large stag, and some caudal vertebræ of either an elephant or a large rhinoceros. F. J. B.

2. *Valley of the Gipping.*

It is in this valley that the only patch of River Gravel of any extent occurs. Above Needham, where the valley is not cut through the lower beds of the Glacial Drift to the Chalk, and where the former occur along the bottom of the valley, it is hard to distinguish any of these later accumulations; but when, below Needham, the valley is cut deeper, so as to lay bare the Chalk on either side, the Glacial beds ending off, as a rule, some way up the flanks, then it is easier to distinguish the low-lying terrace of gravel that skirts the alluvial flat, and is almost entirely separated from the older gravel and sand by the outcrop of Chalk.

The patches mapped by Mr. Blake, at and above Needham, form a distinct terrace at a low level, and so, having the features of a River Gravel, have been coloured as such.

From Pool Houses, on the left bank, about 1½ miles below Needham, there seem to be two terraces of gravel, for three-quarters of a mile south-eastward; and again at the southern part of Shrublands Park, where a very narrow outcrop of Chalk separates the two for some way.

At the old chalk-pit a quarter of a mile N.W. of Claydon Station, both Boulder Clay and gravel occur above the Chalk. In the railway-cutting, and in a pit on its eastern side, close to the station, gravel and sand overlie the Chalk. There are other pits in the gravel along the valley, but none noteworthy.

Below this there are two islands of gravel, in the midst of the alluvium, one about half a mile south of the railway-station, and the other (a mere dot on the map), nearly a mile from the station.

On the opposite side of the river, N.W. of Mockbeggar Hall, Boulder Clay occurs beneath the gravel, close to the edge of the marsh.

There are some small patches of gravel in the bottom of the Coddenham Valley, a narrow strip up the Akenham Valley, and some patches in the Somersham Valley.

Alluvium.

The deposit of the modern streams forms a marshy flat along their courses, which in our district is nowhere half a mile wide.

This marshland occurs continuously along the Gipping and also up some of its tributaries. W. W.

In the S.W. part of the district, owing to the streams flowing to a great extent in a Boulder Clay channel, the narrow alluvium is of a clayey nature. Along the stream from Cockfield to Lavenham, during the July floods of 1875, the alluvial patches formed a chain of small lakes, or meres, as they are here called.

One may here notice a thin bed of alluvial (?) brickearth worked at a brickyard a little west of Welnetham Station, where sandy loam, two feet thick, rests on the Boulder Clay, from the wash of which it seems to have been formed. Teeth (one of horse) have been found in the loam, and I also got a fragment of old pottery. F. J. B.

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APPENDIX I.

Coddenham Brook (A. Nailbourne), 1876.

In August this stream was dry above the chalk-pits (about a mile W.N.W. of the Church) except for a wee hole full of water. The bottom is irregular, and there was a small hollow in chalk a little above the road-bridge.

In September all the lower part of the northerly branch of this stream, above Coddenham, was dry. Its bed is in the Chalk, and shows a number of small basins or swallow-holes, the most marked being about a quarter of a mile above Chippings Hill Farm.

In November the other branch, above Coddenham, was dry, except for small pools (swallow-holes?), and its channel showed a little silt, a good deal of gravel, some chalk-rubble, and in places chalk. Higher up, where it touches the road to Hemingston, there was water for a little way.

In October this branch, northward of Primrose Hill (E. of Hemingston), was dry. It clearly has at times a somewhat torrential character, the bottom showing banks of gravel, sometimes coarse, sometimes cemented. There is also along its course a little silty alluvium, as with most streams flowing over Boulder Clay, but hardly mappable. It is hard to say whether some of the gravel is not of Glacial age, and it seems as if the Chalk were touched in places.

The water, of course, that flows over the Boulder Clay of the highest parts of the valley-branches sinks into the permeable Chalk, except after heavy rains, when there is a continuous flow.

W. W.

APPENDIX 2. WELL-SECTIONS.

Many of these well-sections taken from a paper by the late Rev. W. B. CLARKE are somewhat doubtful; the exact localities are not given, and sometimes there seem to be mistakes in the description of the beds. W. W.

BARHAM. Hall Farm, half a mile E. of the church. 1874.

Information from the tenant (Mr. Hewlitt?) (F.J.B.)

	Feet.
Boulder Clay - - - - - -	12 or 15
Coarse gravel, blue clay, brickearth, sand, blue clay, [Drift, with base-bed of Thanet Sand at bottom?]	about 55
	nearly 70

BARKING.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v. p. 379.

Diluvial [Boulder] Clay to Chalk - 94 feet.

BEIGHTON GREEN.

Communicated by Mr. WARREN, of Bury. (F. J. B.)

Boulder Clay - 10 feet.
Sand - - 25 „

BILDESTON. Lion Inn.

Sunk and communicated by Mr. PETTIT, of Hadleigh. (F, J. B.)

Water rose to the surface.

Chalky rubble - 5 feet.
Chalk - - 10 „

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The wells in the town generally, according to the same authority, give the section Chalky Clay, 30 feet, and Chalk, 10 feet. The Rev. W. B. CLARKE gives the section: Diluvial Clay to Chalk, 60 feet (*Trans. Geol. Soc.*, ser. 2, vol. v. p. 374.)

BRADFIELD.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 375.

Whitish clay	11 feet.
Blue clay	100 ,,
Red sand	34 ,,
	145 ,,

BRADFIELD COMBUST. The Hall.

Communicated by Mr. WARREN. (F. J. B.)

Boulder Clay	30 feet.
Sand and gravel	30 ,,

BRADFIELD ST. GEORGE. Parsonage.

Communicated by Mr. WARREN. (F. J. B.)

Water rose to surface.
Boulder Clay to gravel, 170 feet.

COCKFIELD.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 375.

Blue [? Boulder] clay, 126 feet.

In another well the top 20 feet of the clay was white, and the rest (10 feet) contained pyrites and crumbling shells.

COCKFIELD. Half a mile E. of the Hall.

Communicated by Mr. WARREN. (F. J. B.)

Boulder Clay, to sand and water, 103 feet.

COMBS (near Stowmarket). Mr. Lankester Webb's Tannery, 1855.
MS. in Geol. Soc. Library.

		Ft.	In.
Drift	Yellow clay, with flints	5	6
	Vein of sand with clay or marl	7	0
	Trace of sand	12	2
	Sand with clay	2	7
	Sea sand with pebbles on a powerful chalybeate spring	3	3
	To Chalk	30	6
Chalk, 843½ feet.	Chalk and flints	26	6
	Chalk without flints	504	0
	Chalk Marl, more clayey and finer lower down	240	0
	Chalk Marl, with traces of a green colour and sand increasing and varying in hardness	73	0
Gault and Greensand alternately		21	0
		895	0

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A somewhat different account of this well is given by Mr. P. Bruff, *Proc. Inst. Civ. Eng.*, vol. xix., p. 42, as follows:—

		Feet.
Drift	Clay to the first springs	30
	Sand (very solid)	27
	To Chalk	57
Chalk, 817 feet.	Chalk with flints	504
	Chalk without flints	240
	Chalk with marl	73
Upper Greensand		10
Gault		11
		895

Combs. (J. H. B.)

	Boulder Clay.	Sand.
1. Corner of road near Tricker's Green, $\frac{7}{8}$ mile S.W. of church (good supply)	89	$2\frac{1}{2}$
2. Parsonage (Tricker's Green)	80	—
3, 4. A little further on same road, towards Combs, 2 wells on either side of the road	73	—
	73	12
5. Corner of road half a mile S.E. of the church	51	—

Cotton. Mr. Harries'.
Communicated by Mr. W. H. Penning.
Boulder Clay, to sand, 75 feet.

Creeting.
Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 378.

Gravel	25 feet.
Pebbles in sand	5 „
Chalk	25 „
	55 „

Creeting All Saints, same authority.

Various soils	74 feet.
Diluvial gravel	10 „

Creeting St. Mary, same authority.

Mixed soil		7 feet.
[Drift.]	Gravel	4 „
	Blue clay	2 „
	Sand	10 „
	Rocky substance	2 „
	To Chalk	25 „
Chalk		175 „
		200 „

Crowfield Street, near Coddenham.
G. Maw, *Quart. Journ. Geol. Soc.*, vol. xxiii., pp. 110, 111.

	Feet.
Loamy gravel on the surface	4
Boulder Clay	53
Drift sands and gravels, with much chalk-detritus, varying in character, and with consolidated blocks	43
To Chalk	100
Chalk	11

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Mr. C. B. Rose gives a slightly different version (? of the same well "Crowfield") in *Geol. Mag.*, vol. iv., p. 278, thus:—

Tough Boulder Clay	55 feet.
Sand and gravel, about	45 „
To Chalk	100 „

Drinkstone.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 376.

Diluvial [Boulder] clay - 70 feet.

Drinkstone Park.

Communicated by Mr. Warren. (F. J. B.)

Gravel - - - 25 feet.

Earl Stonham. Rectory.

J. B. Phear, *Trans. Cambridge Phil. Soc.*, vol. ix., p. 438.

[Boulder Clay ?] to gravel, with water - 40 feet.

Elmswell.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 376.

Diluvial [Boulder] clay	40 to 60 feet.
Sand	20 to 30 „

Another well.

[Drift.]	White clay	10 feet.
	Gravel	10 „
	White clay	10 „
	Blue clay with ironstone	20 „
	Blue clay	43 „
		93 „

Great Barton. By a small house ¾ mile S.W. of the church, and S. of the railway. (J. H. B.)

Chalky Boulder Clay	40 feet.
Chalk, to water	60 „

Great Blakenham.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2., vol. V., p. 379.

[Drift.]	Gravel	10 feet.
	Clay	40 „
Chalk, no flints		92 „
		142 „

Great Bricett. Rectory.

Sunk and communicated by Mr. Whellum of Raydon (F. J. B.)

Boulder Clay	100 feet.
Dark green clay (? sandy)	10 „
Coarse sand and pebbles	12 „
Running shingle	10 „
Fine blue [wet] sand	13 „
	145 „

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Great Finborough.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 378.

Clay - -	90 feet.
Sand, to water	30 ,,

Haughley Green.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 376.

Diluvial [Boulder] clay - 60 feet.

Hemingston.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 379.

[Drift]	Loam (London) clay - -	10 feet.
	Plastic clay, gravel, and sand -	40 ,,
Chalk	- - - - - -	45 ,,
		95 ,,

Henley.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 379.

Clay - -	20 feet.
Gravel -	20 ,,

Hesset, at the Church.

Communicated by Mr. Warren. (F. J. B.)

Boulder Clay -	30 feet.
Sand - -	30 ,,

Lavenham, Greyhound Inn, 1827.

Rev. W. B. Clarke, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 375.

[? Boulder Clay.]	Light-yellow clay - - -	14 feet.
	Stiff blue clay, with many chalk-stones -	14 ,,
	Dirty clay and black mould - -	12 ,,
	Clay, with chalk-stones and coal -	30 ,,
White and yellow sand and gravel, with water -		6 ,,
		76 ,,

At 50 feet mephitic air, which put out candles and killed chickens."

Lavenham, three other wells. Same authority.

		Feet.
At the Parsonage.	Blue clay with a layer of chalk-stones -	45
,, Cock Inn.	Clay - - - - - -	45
,, Mill.	Soil and clay - - - -	56

Lavenham. (1) Hall Farm, 1¼ miles N. of the town. (2) A little N. of the former.

From information on the spot. F. J. B.

	(1.)	(2.)
Brickearth - -	10	16 feet.
Gravel and stones -	10	14 ,,
Blue loam - -	10	— ,,
Boulder Clay - -	100	10 ,,
To sand and water -	130	To strong spring 40 ,,

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LAVENHAM. House by the Railway Station.
Communicated by Mr. PORTER, formerly of Lavenham. (F. J. B.)

Boulder Clay, to sand and water	70 feet.

LAVENHAM. Sugar Factory, at stream-level, close by the Railway Station. Communicated by Mr. PORTER. (F. J. B.)

Boulder Clay	10 feet.
Gravel	20 ,,

LAVENHAM. Windmills northward of Railway Station. (F. J. B.)

1. Easterly Mill.

Gravel and sand	25 feet.
Boulder Clay, to sand and water	40 ,,

2. Westerly Mill.

Boulder Clay	40 feet.
Loam	20 ,,

LITTLE BLAKENHAM.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 379.

Water rose to within 62 feet of the surface.

Clay	157 feet.
Chalk	2 ,,

MENDLESHAM.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 376.

Diluvial [Boulder] clay	40 feet.
Chalk	2 ,,

MENDLESHAM. (J. H. B.)

1. A little N. of the church. Boulder Clay, 80 feet.
2. Mendlesham Lodge, nearly a mile W.N.W. of the church ,, 90 feet.
3. Mendlesham Green, 1¾ miles southward of the town (2 wells) ,, 91 ,,

NEEDHAM MARKET. 1807.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 379.

Gravel	10 feet.
Dark blue [Boulder] clay, with chalk stones	8 ,,
To Chalk	18

Another well.

Stiff loam	10 feet.
Gravel	6 ,,
Chalk	24 ,,

NORTON HALL.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 376.

Blue [Boulder] clay and sand	75 feet.

OLD NEWTON.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 378.

Diluvial [Boulder] clay	50 feet.

ROUGHAM, Alms House.
Communicated by Mr. WARREN. (F. J. B.)

Boulder Clay	70 feet.
Sand	20 ,,

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STONHAM ASPAL.

J. B. PHEAR, *Trans. Camb. Phil. Soc.*, vol. ix., pt. iv., p. 442.

Two wells, respectively 45 and 90 feet of Drift clay, over red sand.

STONHAM, Brewery (2 wells).

J. B. PHEAR, *Trans. Camb. Phil. Soc.*, vol. ix., pt. iv. p. 438.

Flat alluvial deposit, to gravelly bed with a perpetual spring, at a depth of 10–15 feet.

STONHAMS. The Four.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 377.

Diluvial clay from 60 to 80 feet.

STOWMARKET. Brewery, in the middle of the town (? before 1850).

From a drawing and description, with a few specimens, entitled "Geological Puzzle for Suffolk," by PROF. J. S. HENSLOW, in the Ipswich Museum, and J. B. PHEAR, *Trans. Camb. Phil. Soc.*, vol. ix., pt. iv., p. 439.

		Feet.
[Drift]	Gravel	7
	Sand	2
	Wet loamy brick clay	4
	Common brick clay	13
	Blue [Boulder] clay, light-coloured at first, then dark, then dark with chalk lumps	27
	Beach sand, with recent marine shells, and strong smell of sulphuretted hydrogen; hard water	18
	To Chalk	71
	Chalk, the top 10 feet soft, the rest hard	250
	Green sand or sandstone. "In a sand-bed in the Chalk, or an incursion from above the Chalk into an oblique fissure?"	9
		330

[The specimens from the "beach sand" are *Tellina solidula, Trochus cinerarius, Purpura lapillus, Nassa, Turritella?* and small pebbles and phosphatic nodules "derived from detrital materials in the red crag," of which formation there may therefore be a trace at the bottom. The shells are, as stated, recent. Did they all come from the well?]

STOWMARKET. Mr. W. R. Hewitt's Mill. 1867.

Sunk and communicated by Mr. T. TILLEY.

		Feet.
[Drift]	Loam, sand, and gravel	20
	Sharp sand with stones and lumps of quartz	80
	To Chalk	100
Chalk	Rubbly chalk and flints (very loose), with much water	200
	Very hard chalk about	15
		315

From the same authority we learn that at the Paper Mills the section is about the same, but it is only 50 feet to chalk, and that at Mr. Prentice's Mill it is 72 feet to chalk, in both cases the sand being less sharp.

The Rev. W. B. CLARKE notices a well here, but in Drift only (dark stiff clay 16 feet; sand 54 feet), though he classifies the beds as London and Plastic Clays. *Trans. Geol. Soc.*, ser. 2, vol. v., p. 378.

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STOWMARKET. Brickyard, a quarter of a mile W. of the church.

From information on the spot. (J. H. B.)

Good supply of water, which rose 50 feet in half an hour.

Brickearth - -	about	30 feet.
Chalky Boulder Clay	„	73 „
Sand, bored into -	„	10 „
		113 „

STOW UPLAND (near).

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 378.

Diluvial [Boulder] clay, to sand and water, 105 feet.

TOSTOCK.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 376.

Gravel, 55 feet.

WETHERDEN. (J. H. B.)

1. About a mile N. of the church, W. side of road. Boulder Clay, 53 feet.
2. Bugs Farm, over 1½ miles N. of the church. Boulder Clay, 70 feet.

WETHERDEN HALL, about a mile N.E. of the village.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 376.

Diluvial [Boulder] Clay - -	40 feet.
Sand - - - -	20 „

WETHERINGSETT. Farm midway between Blacksmiths Green and White House (eastward), about 1½ miles S.E. of the church. (J. H. B.)

Boulder Clay - - 80 feet.

WILLISHAM. Two wells, No. 2 at the Hall.

Rev. W. B. CLARKE, *Trans. Geol. Soc.*, ser. 2, vol. v., p. 379.

	(1.)	(2.)
Clay - -	146	2 feet.
Chalk - -	3	190 „

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INDEX OF PERSONS AND PLACES.

Akenham, 3, 4, 11, 17.

Barham, 3, 4, 9, 15, 18.
Barking, 1, 3, 4, 18.
Baylham, 7.
Beighton, 1, 18.
Bildeston, 1, 6, 18.
Bradfield Combust, 19.
„ St. Clare, 1.
„ St. George, 1, 16, 19.
Brent Eleigh, 5.
Brett, River and Valley, 1, 5.
Bruff, P., 20.

Clarke, Rev. W. B., 7, 18–25.
Claydon, 3, 4, 9, 10, 17.
Cockfield, 1, 5, 16, 17, 19.
Coddenham, 1, 3, 4, 8, 9, 18.
„ Brook and Valley, 1, 3, 8, 9, 17, 18.
Combs, 2, 19, 20.
Cotton, 20.
Creeting, All Saints, 20.
„ St. Mary, 8, 20.
„ St. Peter, 3, 15.
Creetings, The, 7, 20.
Crowfield, 8, 20, 21.

Deben, The, 1.
Drinkstone, 15, 16, 21.

Earl Stonham, 21.
Elmswell, 16, 21.
Etheridge, R., 4.

Gedding, 1.
Gipping, 1.
„ River and Valley, 1–3, 5–11, 15, 17.
Great Barton, 3, 21.
„ Blakenham, 3, 7, 21.
„ Bricett, 1, 21.
„ Finborough, 6, 22.

Haughley Green, 22.
Hemingston, 3, 8, 14, 18, 22.
Henley, 11, 22.
Henslow, Prof. J. S., 24.
Hesset, 22.
Hitcham, 5.

Kettlebarston, 6.

Lark, River and Valley, 1, 2, 6, 11.
Lavenham, 1, 5, 12, 16, 17, 22, 23.
Little Blakenham, 3, 4, 23.

Maw, G., 8, 20.
Mendlesham, 1, 23.
Mickfield, 1.

Needham Market, 3–5, 7, 8, 12, 14, 17, 23.
Norton, 11, 23.

Offton, 3.
Old Newton, 23.
Onehouse, 6, 13.

Penning, W. H., 20.
Pettit, —, 18.
Phear, J. B., 7–9, 14, 15, 21, 24
Porter, —, 23.
Preston, 5.
Prigg, H., 16.

Rattlesden, 6.
Rose, C. B., 21.
Rougham, 1–3, 23.
Rushbrooke, 2, 6, 11, 12.

Shelland, 16.
Shrublands, 3, 9, 15, 17.
Somersham, 4, 7, 17.
Stonham Aspal, 24.
Stonhams, The, 1, 7, 24.
Stowmarket, 1, 6, 13–15, 24, 25.
Stow Upland, 25.

Thorpe Morieux, 1.
Thurston, 2, 3, 6, 11, 12.
Tilley, T., 24.
Tostock, 16, 25.

Warren, —, 18, 19, 21–23.
Welnetham, 2, 17.
West Creeting, *see* Creeting St. Peter.
Wetherden, 1, 6, 13, 25.
Wetheringsett, 25.
Whellum, —, 21.
Willisham, 25.
Wood, S. V., 5, 11, 12.
Woolpit, 6, 11–13, 15, 16.

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COAL FIELDS OF THE UNITED KINGDOM ARE ILLUSTRATE FOLLOWING PUBLISHED MAPS OF THE GEOLOGICAL SURV

COAL-FIELDS OF UNITED KINGDOM.

(Illustrated by the following Maps.)

Anglesey, 78 (SW).
Bristol and Somerset, 19, 35.
Coalbrook Dale, 61 (NE & SE).
Clee Hill, 53 (NE, NW).
Denbighshire, 74 (NE & SE), 79 (SE).
Derby and Yorkshire, 71 (NW, NE, & SE), 82 (NW & SW), 81 (NE), 87 (NE, SE), 88 (SE).
Durham, 105.
Flintshire, 79 (NE & SE).
Forest of Dean, 43 (SE & SW).
Forest of Wyre, 61 (SE), 55 (NE).
*Lancashire, 80 (NW), 81 (NW), 89 (SE, NE, NW, & SW), 88 (SW). (For corresponding six-inch Maps, see detailed list.)
*Leicestershire, 71 (SW), 63 (NW).
Northumberland and Durham (N. part), 105 (NE & SE).
*North Staffordshire, 72 (NW), 72 (SW), 73 (NE), 80 (SE), 81 (SW).
*South Staffordshire. 54 (NW). 62 (SW).
Shrewsbury, 60 (NE), 61 (NW & SW).
South Wales, 36, 37, 38, 40, 41, 42 (SE, SW).
*Warwickshire, 62 (NE & SE), 63 (NW & SW), 54 (NE), 53 (NW).
Yorkshire, 88, 87 (SW), 93 (SW), &c.

SCOTLAND.

*Edinburgh, 32, 33. *Haddington, 32, 33.
Fife and Kinross, 40, 41., &c. &c.

IRELAND.

*Kanturk, 174, 175. *Castlecomer, 128, 137.
*Killenaule (Tipperary), 146.
(For Sections illustrating these Maps, see detailed list.)
* With descriptive Memoir.

GEOLOGICAL MAPS.

Scale, six inches to a mile.

The Coalfields of Lancashire, Northumberland, Cumberland, Westmorland, Durham, Yorkshire, Edinburghshire, Haddington, Fifeshire, Renfrewshire, Dumbartonshire, Dumfriesshire, Lanarkshire, Stirlingshire, and Ayrshire are surveyed on a scale of six inches to a mile.

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47. Clitheroe.
48. Colne, Twiston Moor.
49. Laneshaw Bridge.
55. Whalley.
56. Haggate. 6s.
57. Winewall.
61. Preston.
62. Balderstone, &c.
63. Accrington.
64. Burnley.
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71. Haslingden.
72. Cliviger, Bacup, &c.
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79. Entwistle.
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86. Adlington, Horwick, &c.
87. Bolton-le-Moors.
88. Bury Heywood.
89. Rochdale, &c.
92. Bickerstaffe, Skelmersdale.
93. Wigan, Up Holland, &c.
94. West Houghton, Hindley, Atherton
95. Radcliffe, Peel Swinton &c.
96. Middleton, Prestwich, &c.
97. Oldham, &c.
100. Knowsley, Rainford, &c.
101. Billinge, Ashton, &c.
102. Leigh, Lowton.
103. Ashley, Eccles.
104. Manchester, Salford, &c.
105. Ashton-under-Lyne.
106. Liverpool, &c.
107. Prescott, Huyton, &c.
108. St. Helen's, Burton Wood.
109. Winwick, &c. 6s.
111. Cheedale, part of Stockport, &c.
112. Stockport, &c. 4s.
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Scale, six inches to a mile

Sheet.
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3. Jarrow. 4s.
4. S. Shields. 4s.
5. Greenside. 4s.
6. Winlaton.
7. Washington.
8. Sunderland.
9. ——— 4s.
10. Edmond Byers. 4s.
11. Ebchester.
12. Lantoydy.
13. Chester-le-Street. 6s.
14. Chester-le-Street.

Durham—cont.

Sheet.
16. Hunstanworth.
17. Waskerley.
18. Muggleswick.
19. Lanchester. 6s. Vertical Section, 39.
20. Hetton-le-Hole.
24. Stanhope.
25. Wolsingham.
26. Brancepeth.
32. White Kirkley.
33. Hamsterley.
34. Whitworth.
41. Cockfield.
42. Bishop Auckland.

Northumberland.

Scale, six inches to a mile.

47. Coquet Island. 4s.
56. Druridge Bay, &c.
63. Netherwitton.
65. Newbiggin. 4s.
68. Belingham.
69. Redesdale.
72. Bedlington.
73. Blyth. 4s.
77. Swinburn.
78. Ingoe. 6s.
80. Cramlington.
81. Earsdon.
84. Newborough.
85. Chollerton.
86. Matfen.
87. Heddon-on-the-Wall.
88. Long Benton.
89. Tynemouth.
92. Haltwhistle.
95. Corbridge.
96. Horsley. 4s.
97. Newcastle-on-Tyne.
98. Walker. 4s.
101. ———
102. Allendale Town.
105. Newlands.
107. Allendale.
108. Blanchland.
109. Shofleyfield.
110. Wellhope.
111. Allenheads.

Yorkshire.

100. Limley.
184. Kelbrook.
201. Bingley.
204. Aberford.
216. Bradford.
217. Calverley.
218. Leeds.
219. Kippax.
231. Halifax.
232. Birstal.
233. East Ardsley.
234. Castleford.
246. Huddersfield.
260. Honley.
272. Holmfirth.
273. Penistone.
274. Barnsley.
275. Darfield.
276. Brodsworth.
281. Langsell.
282. Wortley.
283. Wath upon Dearne.
284. Conisborough.
287. Low Bradford.
288. Ecclesfield.
289. Rotherham.
290. Braithwell.
293. Hallam Moors. 4s.
295. Handsworth.
296. Laughton-en-le-Mor
299. ———.
300. Harthill.

SCOTLAND.

Scale, six inches to a mile.

Edinburghshire.

2. Edinburgh, &c.
3. Portobello, Musselburgh, &c.
6. Gilmerton, Burdie House, &c.
7. Dalkeith, &c.
8. Preston Hall. 4s.
12. Penicuick, Coalfield
Lasswade, &c.
13. Temple, &c.
14. Pathead. 4s.
17. Brunston Colliery,
18. Howgate.

Haddingtonshire.

Six inches to a mile.

8. Prestonpans, &c. Price 4s.
9. Trenent, Gladsmuir, &c. Price 6s.
13. Elphinstone, &c. Price 4s.
14. Ormiston, East Salton, &c.

Fifeshire.

Six inches to a mile

24. Markinch, &c.
25. Scoonie, &c.
30. Beath, &c.
31. Auchterderran. 4s.
32. Dysart, &c.
33. Buckhaven.
35. Dunfermline.
36. Kinghorn.
37. Kinghorn. 4s.

Ayrshire.

Six inches to one mile.

19. Newmilns.
26. Glenbuck. 4s.
27. Monkton, &c.
28. Tarbolton, &c.
30. Aird's Moss.
31. Muirkirk. 4s.
33. Ayr, &c.
34. Coylton.
36. Grieve Hill.
40. Chiltree.
41. Dalleagler.
42. New Cumnock.
46. Dalmellington.
47. Benbeock.
50. Daily.
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